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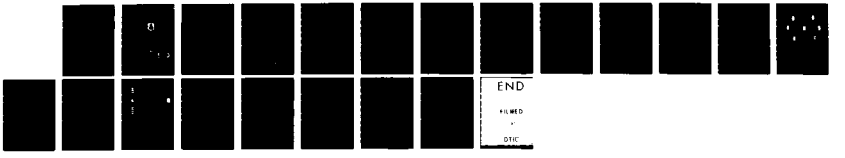

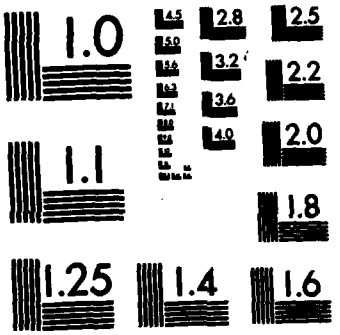

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FOREIGN TECHNOLOGY DIVISION

THE MINICOMPUTER SYSTEM FOR SEAT RESERVATIONS (MSRM)

by

Czeslaw Syc

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THE MINICOMPUTER SYSTEM FOR SEAT RESERVATIONS (MSRM)

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THE MINICOMPUTER SYSTEM FOR SEAT RESERVATIONS (MSRM)

Czeslaw Syc, The Center for Information Technology in Warsaw

The new possibilities and feasibilities in using telex networks for the needs of making reservations that have emerged from the development and adoption of the Base Information Telex System (BIST, Polish abbreviation) [4], has made possible the conception of the MSRM minicomputer seat reservation system, which will be presented in this article. This conception is based on a completely different principle of system organization and other principles different from those according to which the design of information systems for making seat reservations have been guided up to the present time. Instead of a central data bank based on a single large computer, simplified data banks are proposed based on minicomputers; instead of storing card files with complete data on reserved seats, there will be a data branching structure for reserved seats whose files will include only data giving the unit number (for example, train car or autobus) and the seat number; instead of designing a new organizational system for seat reservations, it is proposed to use the existing one; instead of constructing new spaces for large computers, it is proposed to use existing spaces and structures. In sum, therefore: instead of constructing new computer centers and a special computer communications network, it is proposed to use existing spaces, structures, and minicomputers made within Poland, as well as the BIST [Base Information Telex System]; instead of enormous amounts of investment capital, costs will be minimalized.

Analysis of the Existing Seat Reservation System

Present conditions in the area of seat reservations in the PKP [Polish State Railroads] and the PKS [Polish Motor Transport] may be characterized principally from two vantage points: the user and the institution itself, that is, those entities interested in the reservations themselves as well as in the sale of "reserved-seat tickets," POLRES and ORBIS.

An appraisal from the point of view of the user tends to be critical, and the reasons for this are the difficulties well known to us which have an objective nature. First of all, these are difficulities arising from a lack of reserved-seat

tickets for popular locales during peak periods of demand for transportation, and secondly, the lack of good information on the availability of reserved-seat tickets and the excessive waiting time for waiting on clients in reservation and sales offices.

The purpose of the MSRM is to rectify the client service situation, that is, to create a system of correct information regarding reserved-seat tickets, as well as to shorten the time required for waiting on clients as much as possible in reservation and sales offices. A rapid response to an order for reserved-seat tickets coming from the MSRM system can have an influence on the pertinent system of forming trains as well as on planning for additional trains, and in this way, the obtive difficulties will be ameliorated.

At the present time, as has already been mentioned, two institutions have the job of drawing up seat reservations for the PKP and the PKS, and they are namely the following:

- POLRES in the area of overnight sleeping reservations, simple seating places, and places for lying down (couchettes) in international trains, seating places in domestic traffic trains, as well as places in the long-distance autobuses of the PKS;

- ORBIS in the area of overnight sleeping accommodations and couchettes in domestic train traffic.

For the purpose of a more precise characterization of the scale of problems in seat reservations, from the point of view of the reservation office, results of an analysis of work carried out by the POLRES reservation office are presented in this article; the analysis was carried out on the basis of data from the Central Dispatching Office for Seat Assignments (CDRM), which is subordinate to POLRES. The data was collected thanks to the kindness of the management and workers. It emerges from this analysis that the overall number of seats subject to reservation (the so-called "available places") exceeded 14 million in 1978. The use of available places or available seats is illustrated in the accompanying table, with the situation broken down into individual kinds of transportation.

The use of available places in the traditional POLRES reservation system (data from 1978)

Type of transportation / Use of places		Available places	Reservations	Reservations made and/or used
International transportation	PKP	5,230,747	2,539,679	49
Domestic transportation	PKP	6,720,230	3,400,964	51
	PKS	2,429,624	286,309	12
	PKP-PKS	96,820	2,271	6.2

In 1978 daily reservations were available on 36 international trains and 32 domestic trains (without including places coming under ORBIS). These average numbers do not take into account the diversity arising at times, for example when the composition of the trains is nonuniform (one train may be composed of from 5 to 16 train cars), nor the variability in the number of trains at times (seasonally running train cars). The invariant element (that is, the invariant unit) in the PKP reservation system is the train car used in the following categories (the use of abbreviations here is in accordance with the nomenclature used by the PKP):

- a first class sleeping car, WLA: 10 compartments with two places each;
- second class sleeping car, WLB: 10 compartments with three places each;
- car with places for lying down, BC: 10 compartments (including compartments for nonsmokers) with six places each;
- car with seating places, I class, A: 10 compartments (five for nonsmokers) with six places each;
- car with seating places, II class, B: 10 compartments (five for nonsmokers) with eight places each.

In the area of making seat reservations in the presently functioning traditional system, the following order is in effect:

Booking clerk	CDRM dispatcher
- determines the customer's needs and telephones the dispatcher requesting information on seats in which the customer is interested (train, day, number, and type of places).	- transmits information to the booking clerk on the places available (number of reserved-seat tickets) or information concerning their lack.
- after reaching a settlement with the customer, confirms the reservation and gives his identification number.	
- breaks off contact with the dispatcher and fills out the reserved-seat tickets, collecting the amount due.	- enters the reservation in the scheduling chart (identification numbers of the booking clerk and the dispatcher).

From this reservation procedure it emerges that the process for making reservations is broken down into three stages:

1. customer's approach to the booking clerks (many customers for one booking clerk);
2. contact between the CDRM booking clerk and dispatcher (many booking clerks for several dispatchers);
3. dispatcher approach to scheduling chart (as a rule, several dispatchers for one scheduling chart).

The scheduling chart is the basic document laying out and describing the railroad cars. All information regarding the reservations situation is written into the railroad car scheduling chart. Reservations can be made 30 days previous to train departure in international transportation (60 days for return trip), as well as 60 days previous in domestic transportation (90 days for return trip).

From the section presented above concerning the seat reservation process, it may be seen that there is a marked influence of the time duration of stage 3 on stages 1 and 2. The use of minicomputer equipment for carrying out stages 2 and 3 increases the speed of moving the waiting line through the cashier's office,

and in this way reduces the waiting time in line. The purpose in the quite simple method described here is to shift from the present system to the MSRM system. It is not, however, the only purpose. Among the expectations of the POLRES office connected with the introduction of the MSRM system, it is necessary to mention the collection of data concerning the following items:

- number of passengers in the individual categories;
- the filling up of the trains;
- return of reserved-seat tickets to the cash collections offices;
- the number of unfilled group orders (a portion of the reservations are made up in a system of priorities for particularly important group trips);
- information on the current state of free seats in individual trains (this can have an effect on breaking up waiting lines in the cash collections offices during a time of great demand for transportation);

In addition, account has been taken of the following items:

- differences between railroad equipment in different countries;
- ticketing offices (daily and total accounting).

In its simplest formulation the present system for seat reservations functions as a selective mechanism in situations where demand for places on the trains cannot be completely fulfilled. It is well known that this state of affairs occurs particularly during periods of great demand for transportation (in July and August during daylight hours). In addition, from the numbers presented in the table it is apparent that utilization of available spaces does not much exceed 50%.

Shown in Fig. 1 is the configuration of the organizational division of available places in the present, traditional system for making seat reservations in POLRES. In all half the places available are divided among six basic seating groups:

- sleeping places and places for lying down in international transportation (not counting the USSR);

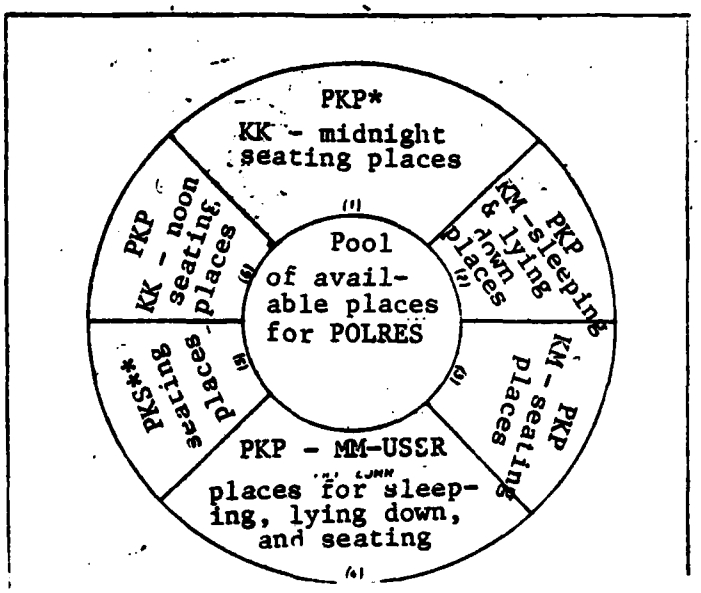


Fig. 1. Diagram of division of available places between organizations in the present traditional system of seat reservations under POLRES. KK - domestic transportation; KM - international transportation.
* Polish State Railroads
**Polish motor transport.

- seating places in international transportation (not counting the USSR);
- in transportation to the USSR;
- in PKS transportation;
- in "noonday" domestic transportation;
- in "midnight" domestic transportation.

The following systems have been accommodated into this organizational structure of the division between available places: telephone communications, schedule chart organization, the organization of card files and reservation services, as well as a system of dividing authority between the institutions whose job it is to make seating reservations (ORBIS, for example, has its own dependent pool of available places).

The BIST System and the Possibilities for Using It for the Purpose of Making Seat Reservations

The BIST system [1-4] makes it possible to use the country's telex network, in cooperation with its subscribers who are properly connected up with it by means

of minicomputers and computer links. For this purpose, all-purpose telegraphic adapters are used, making it possible to service message-switched telegraphic links, for receiving, transmitting, as well as in the automatic calling mode with any kind of telex terminal. This may also be, in addition to a telex station, a minicomputer or a computer. A minicomputer or computer can work together simultaneously in the automatic mode with many subscribers of a telex net thanks to the use of a multiplexer, to which telegraphic adapters are linked. The multiplexer, in this case, makes it possible for any minicomputer or computer to work together with telegraphic adapters. For this purpose, it is sufficient to set up an adapter as output from the multiplexer with the adapter adjusted to the channel interface for the minicomputer or the computer. At the present time, thanks to the kind of multiplexers that exist, the following computers are able to work together with the telex net: the MERA 300, MERA 400, MERA 9150, DP5500, as well as the MERA 60.

It should be emphasized that the telex net is a public ciphered net with automatic switching. This means that within the limits of the entire country it is possible, by means of a normal teleprinter connected at the subscriber level in this net, to reach any other subscriber in the net. At the present time the telex net already contains about 30,000 subscribers. The majority of institutions, including village and city administrations, possess telex stations. Many seat reservations offices are also equipped with these kinds of stations.

In the BIST system, it is also possible to make use of private wire circuits. Slow-working telegraphic links (switched-message links work with bit rates of 50 Bd, and private line circuits up to 200 Bd) in the seat reservations system do not constitute limiting restrictions, because the amount of information constituting a query directed into the MSRM system, and the response from the MSRM system is relatively small (for one transaction this involves severals tens of symbols). In the conversation system for the MSRM subscriber system this kind of communication is completely satisfactory. The most important thing in this case is the manifold increase in the number of links resulting from making it possible for each booking clerk to have instant access to the MSRM seat reservation system. In the BIST system this has been carried out completely on the subscriber levels, at the stations in seat reservations offices, for the booking clerk and for the seat reservation system (MSRM).

In the BIST system it is possible to form message concentrators using minicomputers that can work together with minicomputer or computer centrals as multiposition terminals. The positions for these concentrators may be, in their turn, removed from the concentrators themselves for distances up to 3 km. Each of these kinds of positions may be, in their turn then, local intelligent terminals, adapted on the functional side for the uses of any given position. The basic equipment for a BIST system position is, however, the telex net teleprinter that can work together directly with the MSRM system, in this case, by using the switched-message telex net.

For those who would like to get more closely acquainted with the BIST system, I recommend the works referred to at the end of the article.

The Concept of the MSRM System

As has already been mentioned, one of the characteristic features of the traditional seat reservation system is the division of available places into six groups (Fig. 1). In the MSRM system as well, the identical structure of the division of available places in the seat reservation system has been used (Fig. 2). Problems connected with reserving individual available places for the six groups in the MSRM system can be handled by six minicomputers working together in such a way that at the instant that one of them failed, a neighboring one could take over its work. It has been proposed that MERA 400, SM-3 or SM-4 computers could be used for this purpose. The main tasks for these minicomputers in the MSRM system would be the following:

- automatic seat reservation in the multiaccess mode at the request of the operator of a distant terminal and handled through the instructions of the operator attending the terminal;
- automatic seat reservation in a multiaccess system on the instructions of an operator attending a local VDU terminal;
- entering data into the data bases having to do with seat reservations or data from the return of reserved-seat tickets;
- putting together new data bases concerning, e.g. the opening up of reservations for a certain day;

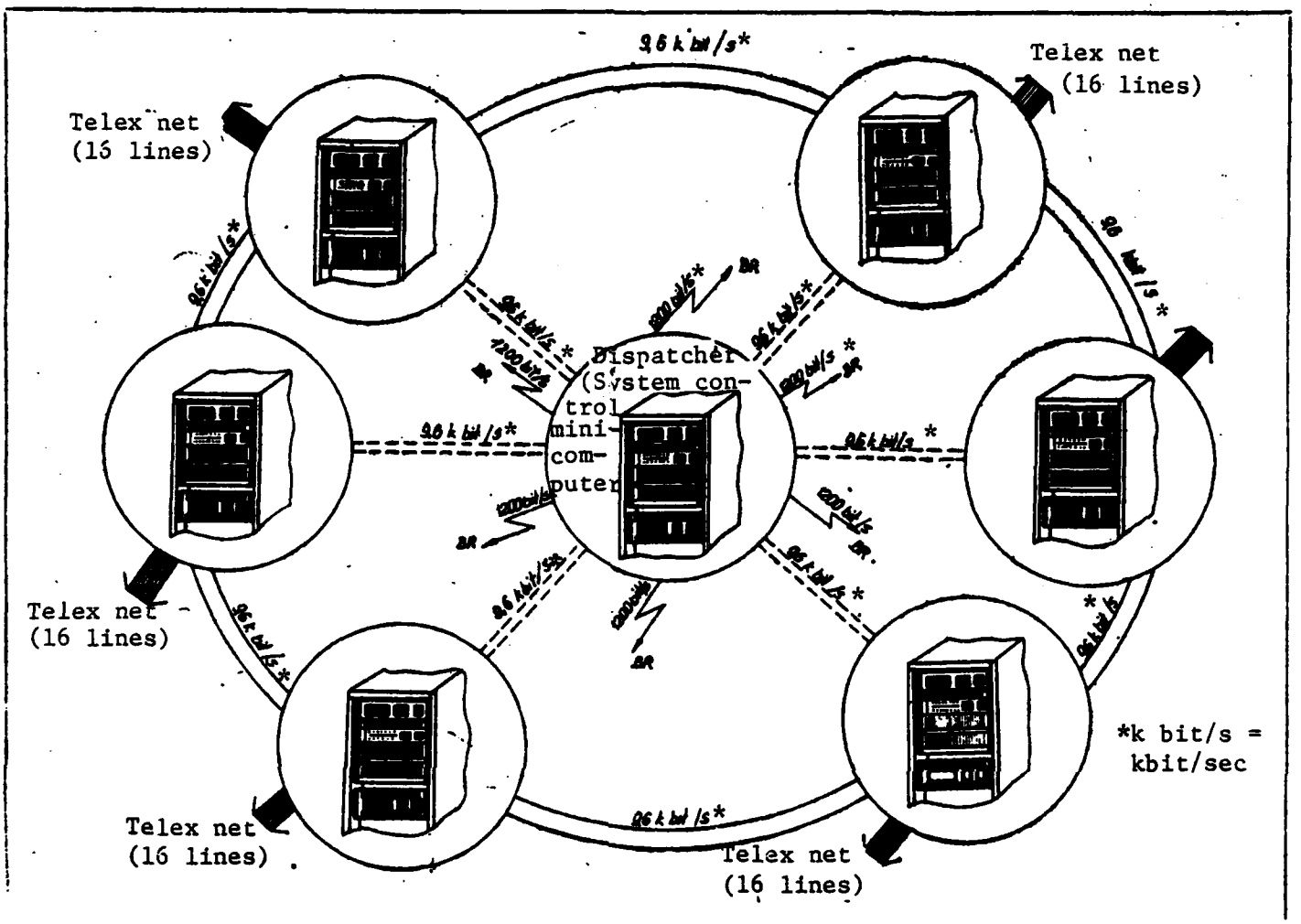


Fig. 2. Configuration of the MSRM System.

- recording reserved and selected reserved-seat tickets;
- producing by automatic means the scheduling diagrams for the conductors and special services;
- preparing statistical data used for, among other things, planning the make-up of trains;
- carrying out information services on the number and type of unreserved places;
- carrying out both remote direct working from the terminal, as well as local working, similarly as this is done in the traditional system, including using the telephone to pass on information about reserved-seat tickets based on data taken from the local terminal visual display unit.

In the first stage it will be sufficient to use six minicomputers, e.g. the MERA 400, for the complete automation of reserving available places in the MSRM system. Each of these kinds of computers would be outfitted with interfaces and multiplexers making it possible for them to work together with the telex net and fixed telephone lines. For the purpose of rationalizing the coordination and control of the individual minicomputers in the MSRM system, it has been proposed that a central system-controlling minicomputer be installed in the second stage of system development. The task of this computer would be mainly servicing communications between the individual reservations offices, as well as supervising the functioning of individual subsystems, confirming available places for reservation for the individual subsystems for particular days, compiling a log of breakdowns and malfunctionings for the individual subsystems, putting together an information system on free places, compiling data bases of special reserved places, etc.

It is assumed that each of the six minicomputers would be outfitted with telecommunications equipment making it possible for them to switch simultaneously to 16 message-switched telegraphic links in the telex network, which has two local lines working together with a bit rate of 9.6 kbit/sec. Lines with bit rates of 9,600 bit/sec would be used for forming a ring of minicomputers (Fig. 2) for the purpose of mutual information exchange between the MSRM subsystems in the event of their breakdown or emergency. Telegraphic lines would make it possible to carry out telex communications between these offices and reservations offices which are at considerable distances from the MSRM center (further than 30 km). In the second stage, all these offices and the reservations offices having sufficiently great numbers of customers could be connected by means of private wire telephone circuits through a concentrator into the MSRM. Those reservations offices having several ticket sales offices for reserved-seat tickets could be switched into the MSRM system through a concentrator implemented, for example, on the MERA 60 minicomputer. For the purpose of assuring sufficient reliability and speed of calling, and for connecting the concentrator with the MSRM, the concentrator would be fitted with at least two message-switched telegraphic links from the telex network, and in the second stage, additionally with private wire telephone circuit links.

The configuration of the concentrator based on the MERA 60 minicomputer planned

for equipping larger ticket reservation offices is shown in Fig. 3. A concentrator

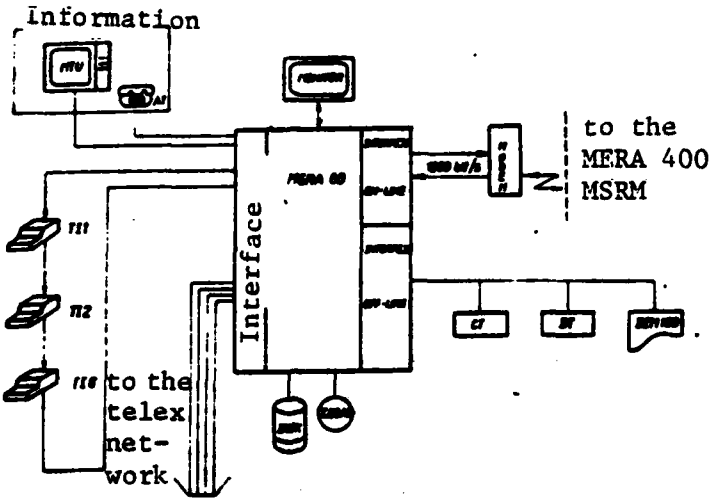
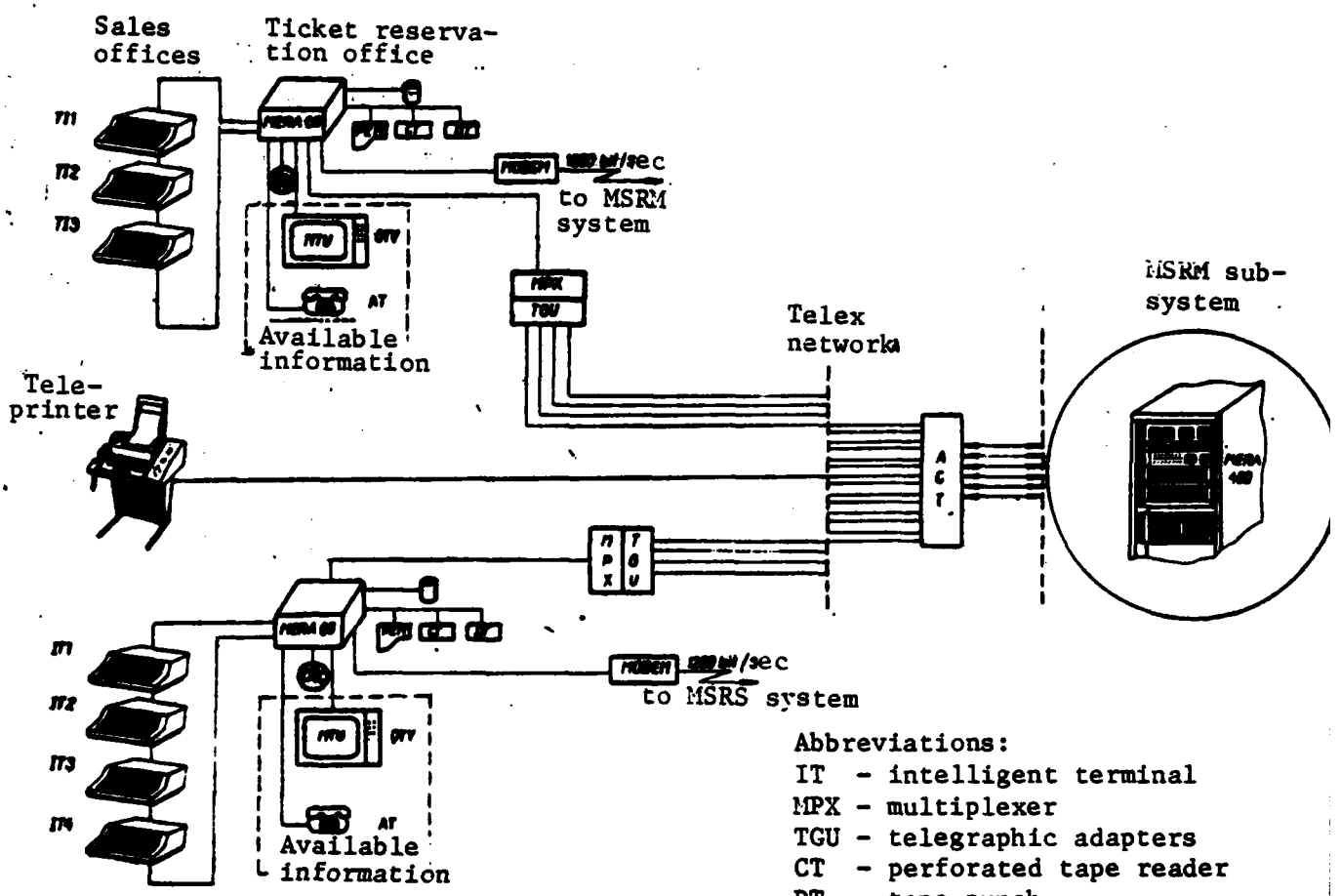


Fig. 3. Configuration of the concentrator implemented on the basis of the MERA 60 minicomputer for the use of large ticket reservation offices. CT - perforated tape reader; DT - perforated tape punch; DZM 180 - matrix printer; TI - local intelligent terminal; MTU - television monitor; AT - pushbutton telephone.

of this kind can provide direct service to the booking clerk windows by using the IT intelligent terminals. In addition, this makes it possible for the customer to get information on the state of reserved seats for particular days, as well as concerning connections.

A section of the configuration of the MSRM system is shown in Fig. 4. Individual cash collection positions, using the IT intelligent terminals in the ticket reservation offices, are automatically connected with the appropriate MSRM subsystem, and they receive information on empty seats, making the reservation after consulting with the customer. In the case of ticket reservations offices having one or two cash collection positions, it is sufficient for each of them to be equipped with a teleprinter switched into the telex network.

It is planned to implement the system in two stages: in the first stage, without a system-control minicomputer, confined to the telex network base, and in the second stage, on the basis of a system-control minicomputer, and in addition — besides using the telex network — to include making use of private wire telephone circuit links. The concentrators from the larger ticket reservation offices



Abbreviations:
IT - intelligent terminal
MPX - multiplexer
TGU - telegraphic adapters
CT - perforated tape reader
DT - tape punch
AT - telephone
OTV - television receiver
MTU - visual display unit
ACT - automatic telephone exchange
ZRC - real-time clock

Fig. 4. Section of MSRM system configuration.

would be connected with the MSRM by means of these links.

Another characteristic feature of the present, traditional system for reserving seats is the standardized format of the information on the reserved-seat tickets. Each reserved-seat ticket contains such data as the train number, train car number or bus number, seat number, travel class in the case of trains, type of seat, departure date and the hour of arrival. For many reserved-seat tickets some of these data are identical, for example, trains are indicated by groups of reserved-seat tickets with the same train number, and the railroad cars are designated by groups of reserved-seat tickets with the same car number. This kind of data format has made it possible to organize the MSRM system data base in such a way that its elements will be only car numbers and seat numbers, while, for example, the train number will only be a node in the information search pathway in the data

base, which will be organized according to a branching tree structure (a forest) as shown in Fig. 5. It has been proposed that in the MSRM system this tree structure

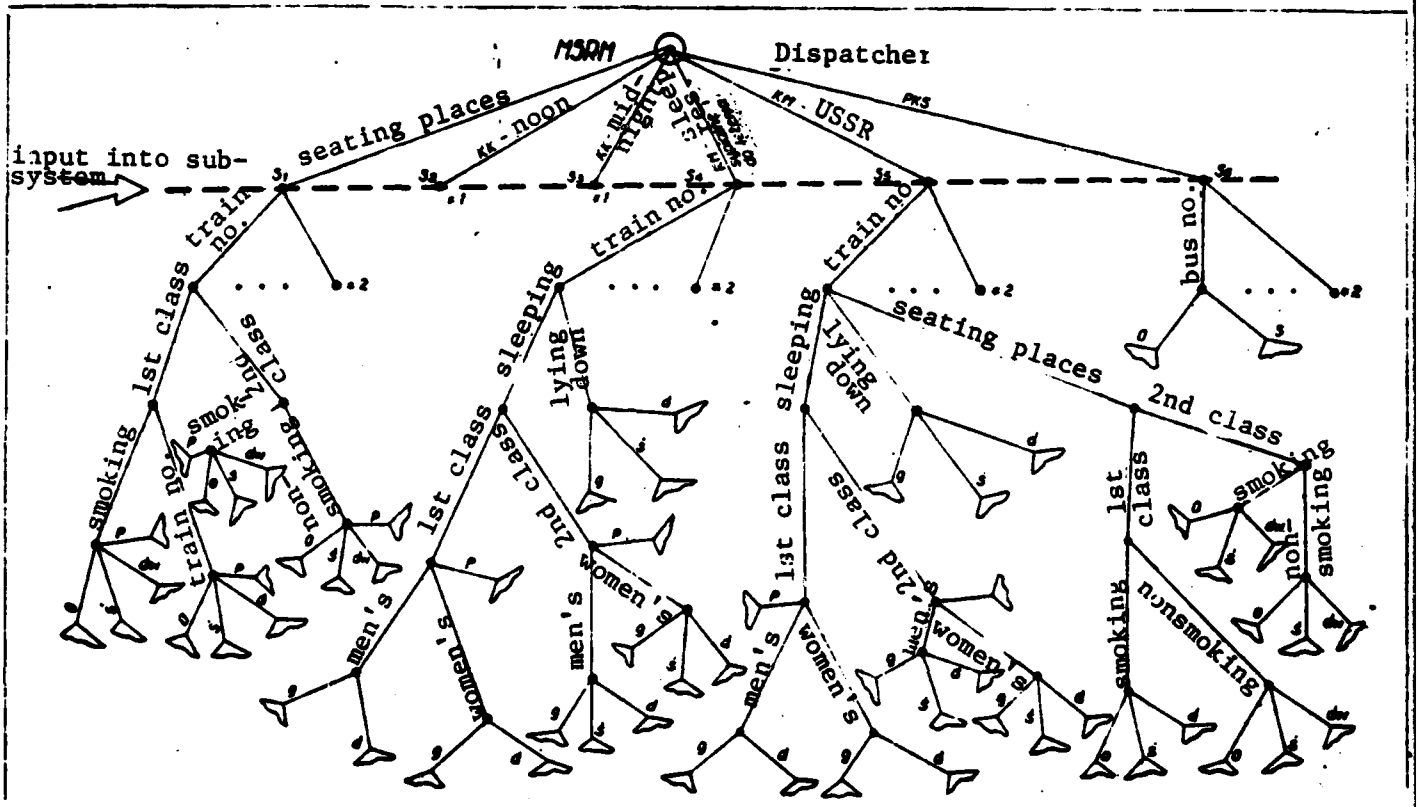


Fig. 5. Tree structure of the data bases for the MSRM system for seat reservations.

*1 - same as KM, seating places; *2 - same for all trains; p - section; g - upper; d - lower; dw - door; o - window; ś - in the middle.

for the data base be accepted, assuring economy of memory as well as rapid access to the data concerning reserved places.

In order to reserve a given place, for example a sleeping place in 1st class for nonsmokers on 25 July 1980, train No. 2802, it is necessary to select the appropriate subsystem (in this case, S_4, shown in Fig. 5), and to then formulate queries into the S_4 system:

- S_4
- 2802, sleeping, 1st class, men's, d, 2507.

The response will include the following data: train number, the sleeping place, 1st class, men's, lower, railroad car number, place number, cost, departure date, hour of departure. With an appropriately construed intelligent terminal equipped with a printer, these data can be printed out directly in the blank spaces on the reserved-seat ticket form, which will be attached to the ticket. We should note that the data contained in the query and the response, with the proper coding, can have an exclusively numerical format. This data format significantly simplifies the terminal design and the method of communicating with the system.

In the case when a customer is interested in a given train number, for example 2802, and the reserved-seat ticket for a particular day, he can get information from the publicly available information station as it is displayed on the screen of the MTU television receiver by entering his query into the concentrator by using the AT pushbutton telephone. The method of formulating the query is by pressing the proper numbered buttons according to code numbers displayed on the MTU television receiver screen. In connection with the tree structure for the data base regarding the reserved-seat tickets (Fig. 5), it is possible to get information very simply and very quickly concerning the number of reserved-seat tickets for each node in the tree structure, that is for example, concerning the number of reserved-seat tickets for a given train, the number of reserved-seat tickets broken down according to 1st class and 2nd class, and the number of reserved-seat tickets broken down according to sleeping places and places for lying down.

From the point of view of the difficulty of simultaneously introducing the MSRM system into all reservations offices, it is planned to retain the present structure of work organization in the CDRM [Central Dispatching for Seat Assignment]. Several telephone operator positions equipped with local monitoring screens hooked directly into the MERA 400 minicomputer and the appropriate MSRM subsystem are to be retained. The telephone operator, using this terminal, will carry out appropriate confirmations in the CDRM with the cash collection positions in the reservations offices, similarly to how this is done at present, with the exception that the reservations will be done by the MERA 400 minicomputer and the appropriate MSRM subsystem using the local terminal from the operator's position in the CDRM.

Stages in Implementing and Adopting the MSRM System

The implementation and adoption of the MSRM system can be broken down into two stages. In the first stage, the MSRM subsystems on the basis of the MERA 400 or SM minicomputers are to be successively implemented with the possibilities, as has already been mentioned, for making reservations as in the conventional system, with the exception that local monitor screens will be used. In this stage the cash collection windows for the reservations offices will be successively equipped with intelligent terminals, and the reservations offices themselves with concentrators, and by means of the telex network it will be possible to carry out automatic communications with the pertinent MERA 400 minicomputer in the MSRM system installed in a room or space in the presently existing, conventional CDRM system in Warsaw. Smaller reservations offices for individual cash collection positions for reservations can be directly equipped with teleprinters, or so-called telex stations, hooked into the automatic telex central exchange, abbreviated the ACT, at the subscriber level. These stations, similarly as in the BIST system, make it possible for individual cash collection positions to make automatic connections with the pertinent MERA 400 minicomputer in the MSRM system for the purpose of making a seat reservation. At this stage, the basic telecommunications network for automatic communications between ticket reservation offices within the MSRM system would be the telex net. The switched-message telephone network would be used similarly as in the conventional system for telephone communication, with the exception that reservations would be carried out by a telephone operator within the CDRM using a local visual display unit monitor connected into the pertinent MERA 400 minicomputer.

In the second stage, the telephone system for reserving seats would be completely done away with. In addition, the larger ticket reservations offices, for example in Warsaw, would have concentrators directly connected into the MSRM system by means of private-wire telephone circuit links. Further, at this stage an additional systems control minicomputer would be introduced into the MSRM system; it would carry out the role of a minicomputer implementing communications with the concentrators within the network of larger ticket reservations offices, which will be connected into the MSRM system by means of private-wire telephone circuit links. In Fig. 2, shaded lines show the place and role of this kind of minicomputer in the

MSRM system. At this stage, it is also possible to introduce, instead of a systems-control minicomputer, a large computer with a central data base composed of local, distributed data bases for the individual subsystems within the MSRM system. In this case, the MERA 400 minicomputers will carry out communications functions within the system, and the large computer will carry out the job of searching for reserved seats, that is, this role would be reversed with respect to the version with a systems-control minicomputer and the MSRM subsystem.

A unique feature of the MSRM system proposed here is the possibility for implementing it in stages depending on the in-place means, the computer equipment used, and the organizational preparation. A significant feature of the system proposed is also its use of existing spaces and rooms for the installation of the computer equipment for the MSRM system. From the point of view of the national economy, it is important to note that the computer equipment to be used for the MSRM is made exclusively in Poland or in the Comecon countries.

The reliability of the MSRM system depends mainly on the computer equipment. Quality improvements in the minicomputers made in Poland can be made in the MSRM system by means of a series of solutions, for example, equipping the minicomputers with reserve disk memories and other auxiliary equipment, linking the minicomputers into a ring structure on the principle of multimachine working, performing periodic printouts of card file contents for place reservations, doubling the implementation of data bases by two contiguous minicomputers, and working in the double-machine ring structure mode (Fig. 2). By means of proper programming, it will be possible to develop great system error resistance and resistance against undesired linking with systems by unauthorized people. The last problem requires, as well, appropriate equipment security.

The costs for implementing the MSRM system, thanks to the application of minicomputers instead of mainframe computers, and thanks to accepting the organizational structure of the present system (in the same way, installing minicomputers in already existing rooms and spaces), to the exploitation of already existing communications, the complete automation of the telex network in the BIST system, and implementation and adoption in a stepwise manner -- thanks to all of this, the costs will certainly be less than a ticket reservations system based on mainframe

computers and a network of terminals connected to them. An equally important matter is the amortization over time of costs, which in the case of the MSRM system is quite possible because of the implementation and adoption of the system in stages. If we are talking about economizing effects, these should also be evaluated, in this case, from the point of view of POLRES, as well as from the point of view of the customers. For POLRES it may be calculated that in the second stage of system functioning it will be possible to make savings of 70% on labor in the CDRM offices as well as improve the functioning of the seat reservation system, which from the point of view of the customer will reduce waiting time at the cash collections window by at least 50%. Poland, because it has its own system of seat and place reservations based on the telex network, can integrate itself, thanks to this, into the international system of seat and place reservations, thus resulting in a greater attraction for foreign tourists to visit our country and for us to augment our foreign currency holdings.

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